California Air Resources Board Workshop
EV Charging Infrastructure Needs

22 September 2009

AeroVironment Inc. – Who We Are

Unmanned Aircraft Systems

Puma 2001   Dragon Eye 2003   Raven 2005   Global Observer *In Dev.*

A Legacy of Innovation

Gossamer Albatross 1979   GM Impact 1990   GM Sunraycer 1987   Helios 2001

Efficient Energy Systems
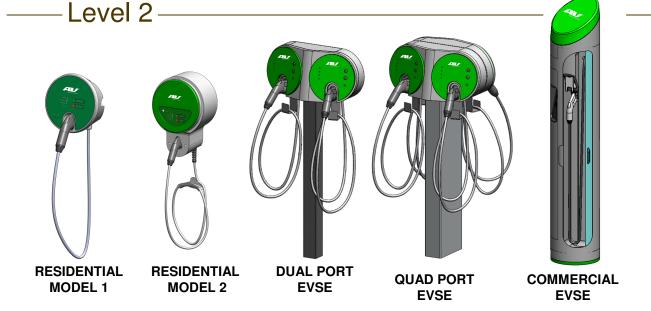
EV Test Systems 1991   On-Road Fast Charge 1995   Off-Road Fast Charge 1999   EV Fast Charge *In Dev.*

EV Charger

Level 2 — Level 3

RESIDENTIAL MODEL 1

RESIDENTIAL MODEL 2

DUAL PORT EVSE

QUAD PORT EVSE

COMMERCIAL EVSE

FAST CHARGER

NEV CHARGER

Application Appropriate Products

- Residential: Garage and MDU

- Fleet & Workplace

- Public: Level 2 and Level 3

- Neighborhood Electric Vehicles

Models shown are concept prototypes. Final production models may vary in appearance, size, color, configuration and other material aspects.

Residential EVSE Model 1 & Model 2 (Level 2)

Category	Feature	Model 1	Model 2
Safety	UL, NEC Compliance	✓	✓
	Ground Fault Interruption	✓	✓
	Microcontroller Self-Test	✓	✓
	User Interface	✓	✓
	Automatic Re-closure	✓	✓
Product Lifetime	Firmware Field Upgradable	✓	✓
	UV Stable	✓	✓
	Expansion Modules	✓	
Communication	Wireless Module Option	✓	
	Data Logging	✓	
Convenience	Built-In Economy Hanger	✓	✓
	Cord Hanger Options	✓	

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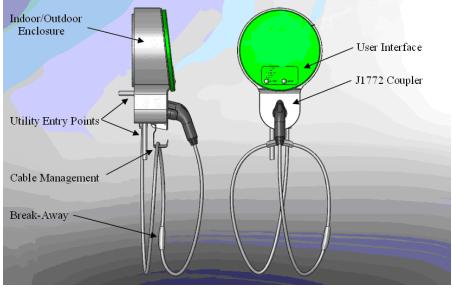
Residential EVSE Projected Specifications

- Usability:
  - No specialized training required
  - Minimal installer training
  - Maintenance free
- Environment
  - -30C to +50C, RH 95% operational
  - -40C to +60C, RH 95% storage
  - Exposure to UV, common automotive chemicals
  - NEMA 4
  - Shipping: Shock and vibration
- Long Service Life
  - >24k charge cycles
- Tolerance to external excursion conditions
  - EV Faults
  - GFI
  - Utility Excursions
- Regulatory Standards
- Establish robust design margins:
  - 10%-20% depending on factor
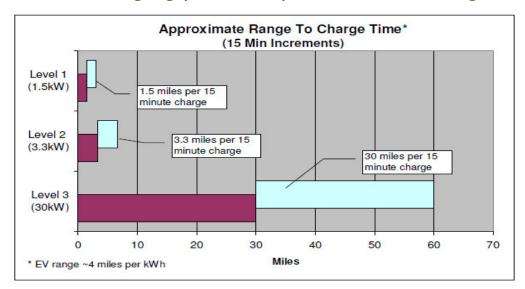 - Application: in-service abuse / handling

95 percentile man

Indoor/Outdoor Enclosure

User Interface

J1772 Coupler

Utility Entry Points

Cable Management

Break-Away

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Level 3 Charging (Fast Charging)

- AV has been fast charging Electric Vehicles for over 20 years
- Fast charging is convenient and enhances the public charging experience
- Level 3 fast charging provides practical "On-the-go charging" solution

Approximate Range To Charge Time*
(15 Min Increments)

Level 1 (1.5kW) — 1.5 miles per 15 minute charge

Level 2 (3.3kW) — 3.3 miles per 15 minute charge

Level 3 (30kW) — 30 miles per 15 minute charge

Miles: 0 10 20 30 40 50 60 70

* EV range ~4 miles per kWh

- "TEPCO" compatible fast charger expected by year-end.
- AV is working with stakeholders such as utilities, governments, and OEM to make Level 3 charging a reality
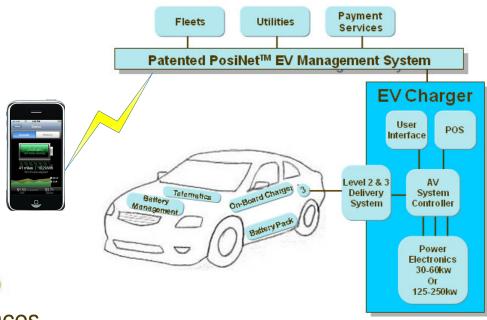- AV is exploring methods to mitigate grid impact

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Lots of EV Charger Innovation and Evolution

- **Evolving infrastructure & standards**
  - SAE J1772 L2
  - SAE J2847
  - SAE J2293
  - Intelligent management of batteries, chargers & vehicles

- **Smart Grid**
  - Smart Energy 2.0
  - Variety of communication interfaces WiFi / PLC / ZigBee / Silver Springs
  - Utility Grade Metering
  - Standardizing Payment Mechanisms
  - Home Area Network Interface

Apple®; iPhone® and iPhone® trade dress are the intellectual property of Apple, Inc. AT&T user interface is the intellectual property of AT&T Wireless Services.

EVSE Installation Projected Workflow

Pre-Sale In-Home Assessment

Appointment

Search and schedule assessment appointments

Appointment confirmation with email, text, or automated phone call

Assessment

Assessment report inputted into Web portal by COB

Purchase & Appointment

Customer data inputted into CRM at point of sale

Search and schedule installation appointments

Appointment confirmation with email, text, or automated phone call

Post-Sale Installation

Installation

Customer feedback through Web portal

Final Inspection

Installation report, including final customer signoff, inputted into Web portal